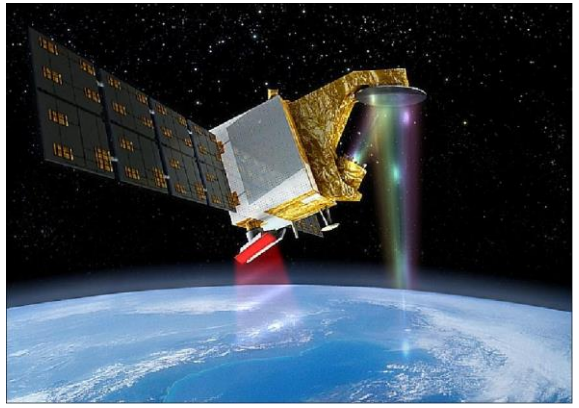


Analysis of Wind and Waves from CFOSAT

Suchandra Aich Bhowmick and Seemanth M.

Space Applications Centre

Indian Space Research Organization

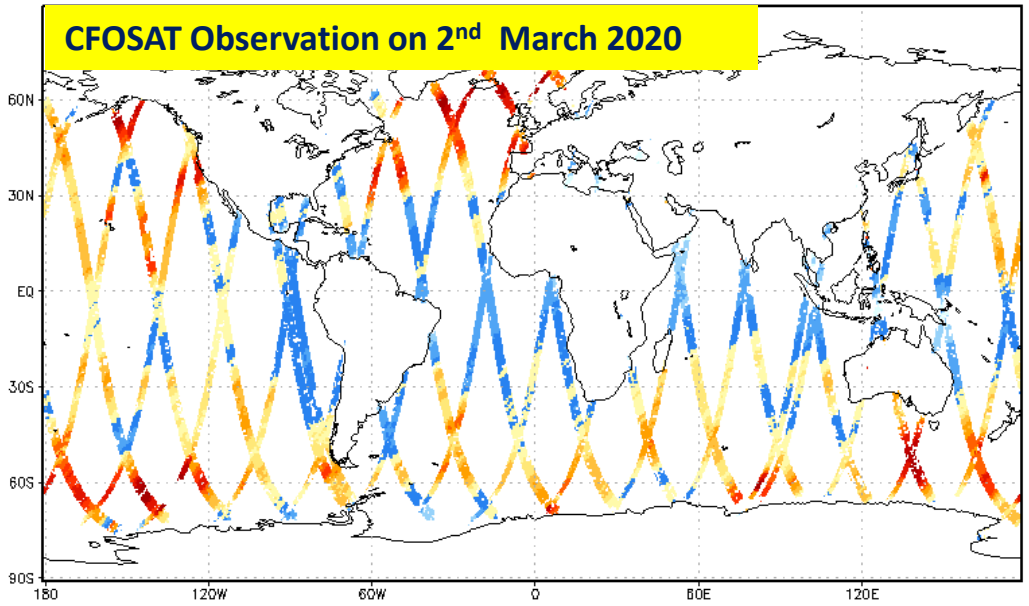
Ahmedabad, INDIA

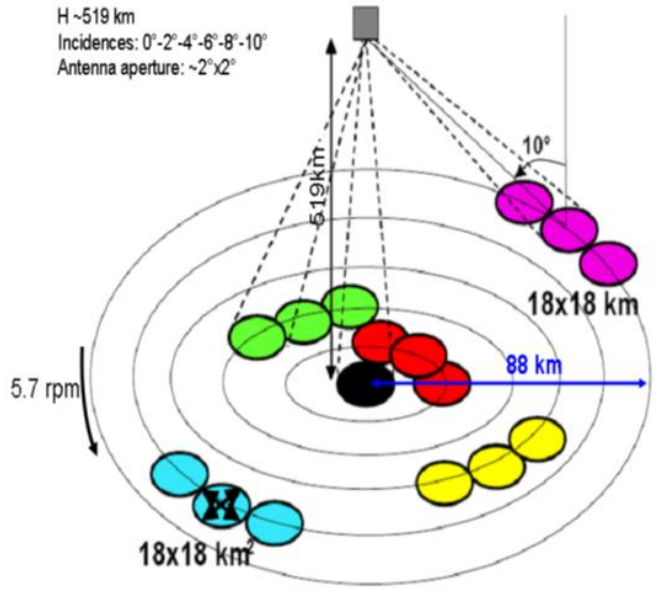
Objective of Analysis

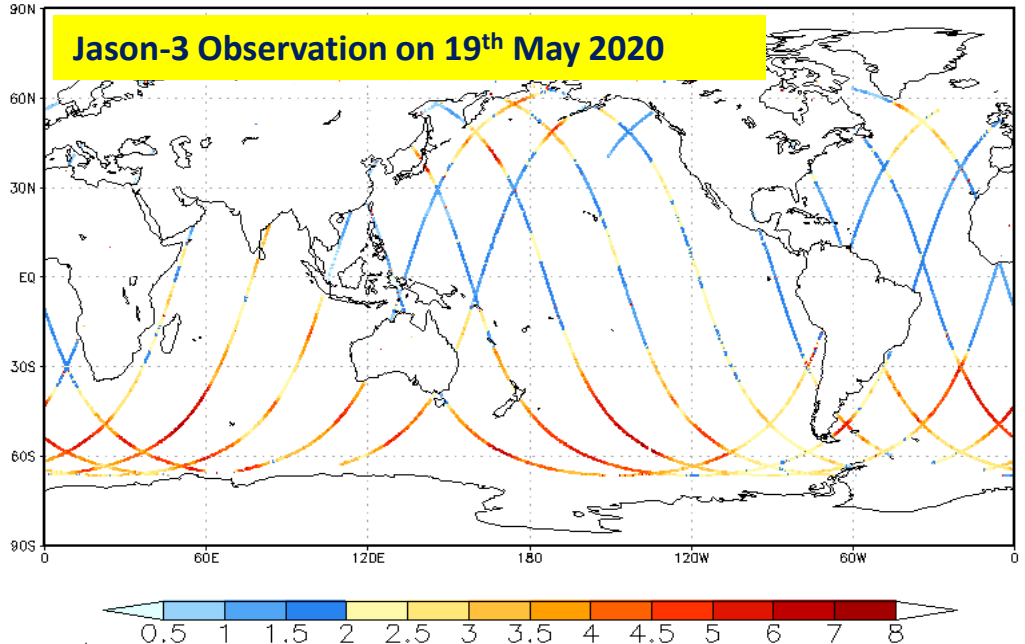
- The advantage of CFOSAT viewing geometry over its peers
- A brief validation of the current version of the data
- A brief details of improvement between two data version of CFOSAT
- The impact of its innovative geometry on mesoscale studies.
- An attempt to assimilate the SWH of CFOSAT in wave model.

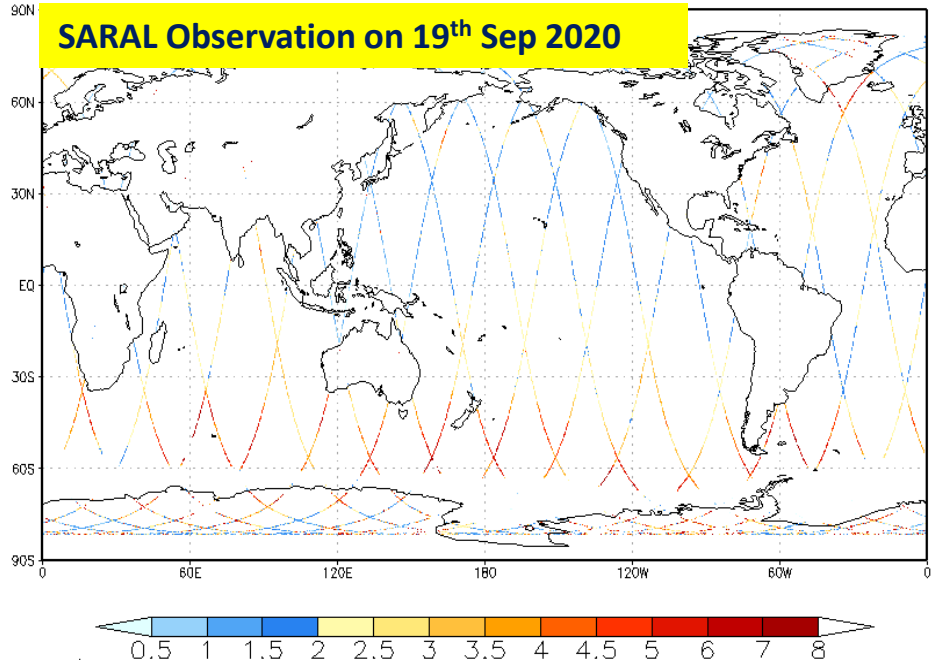
Advantage of CFOSAT's innovative geometry

Currently Orbiting Altimeters



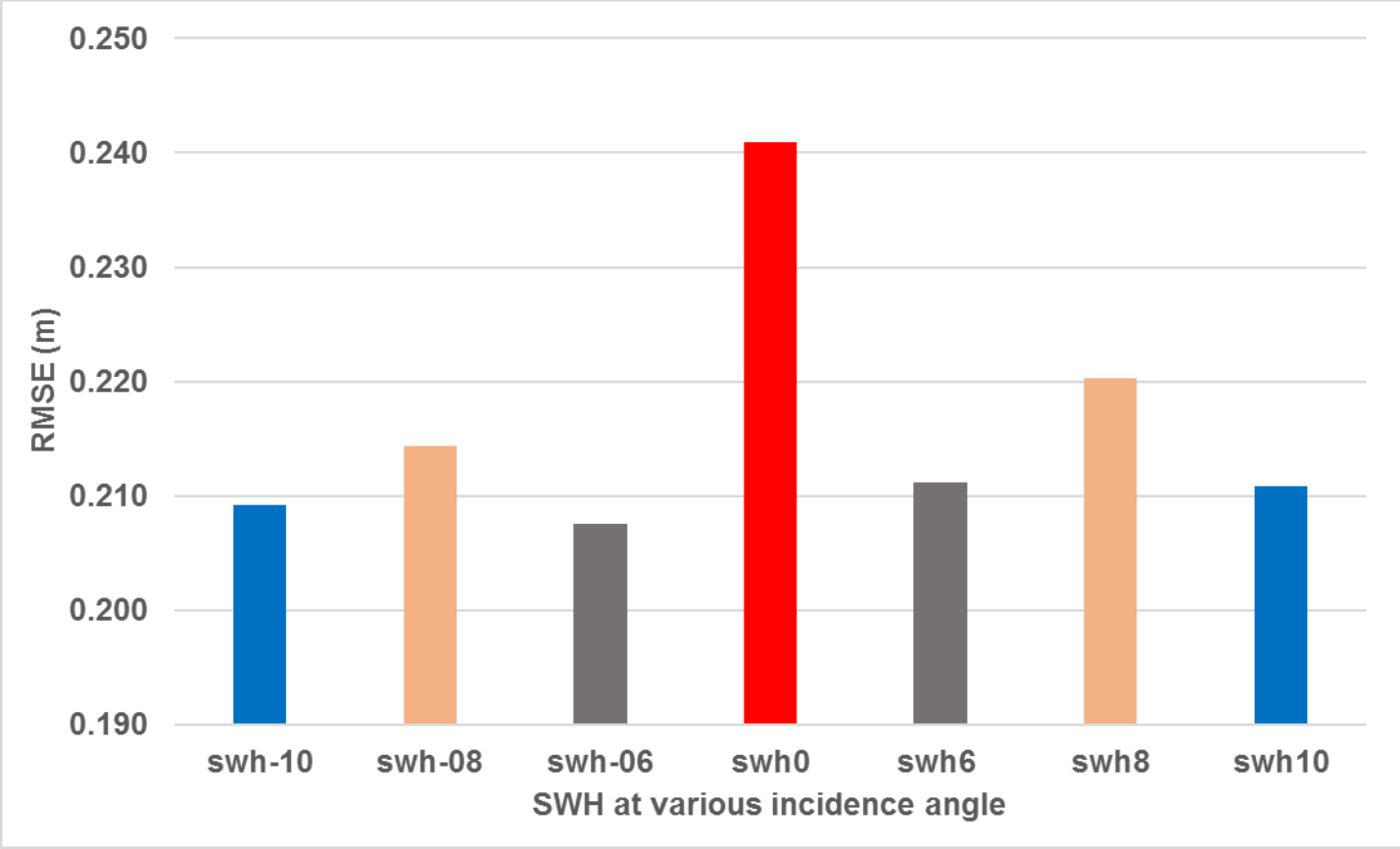


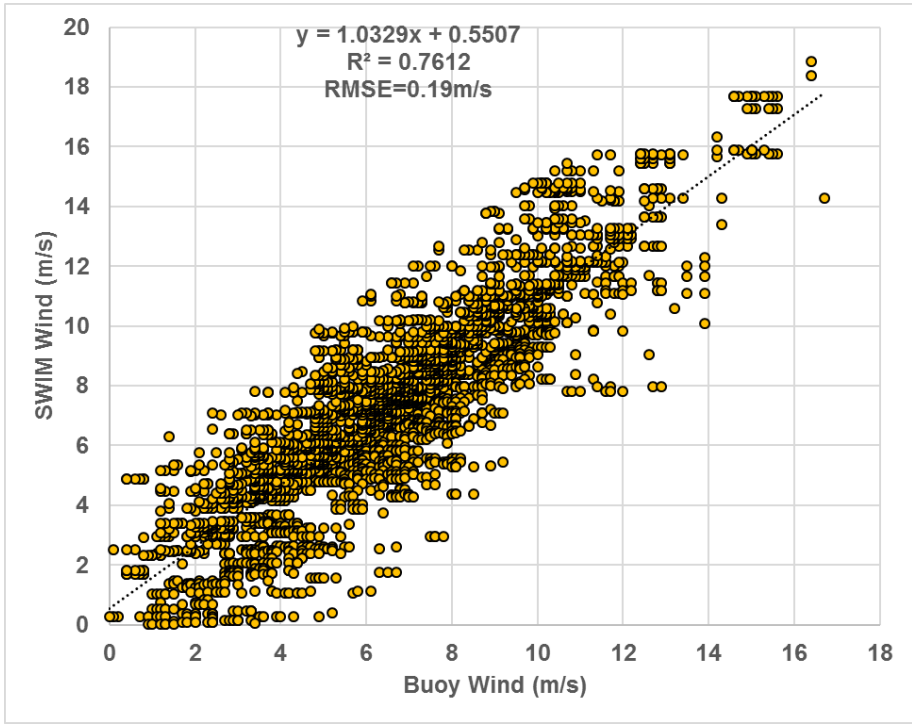




Quality of the observation

Latest data processing chain

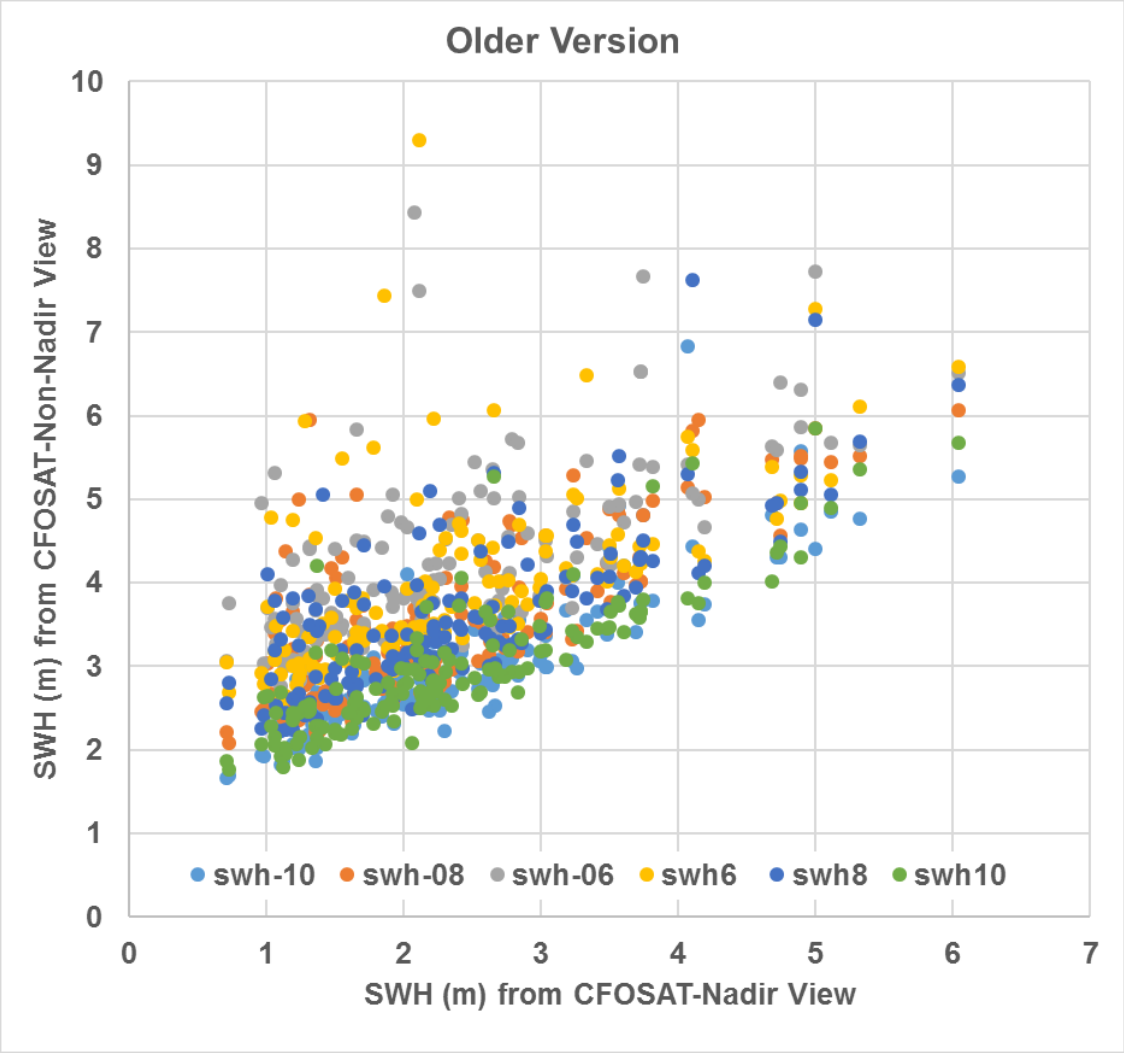


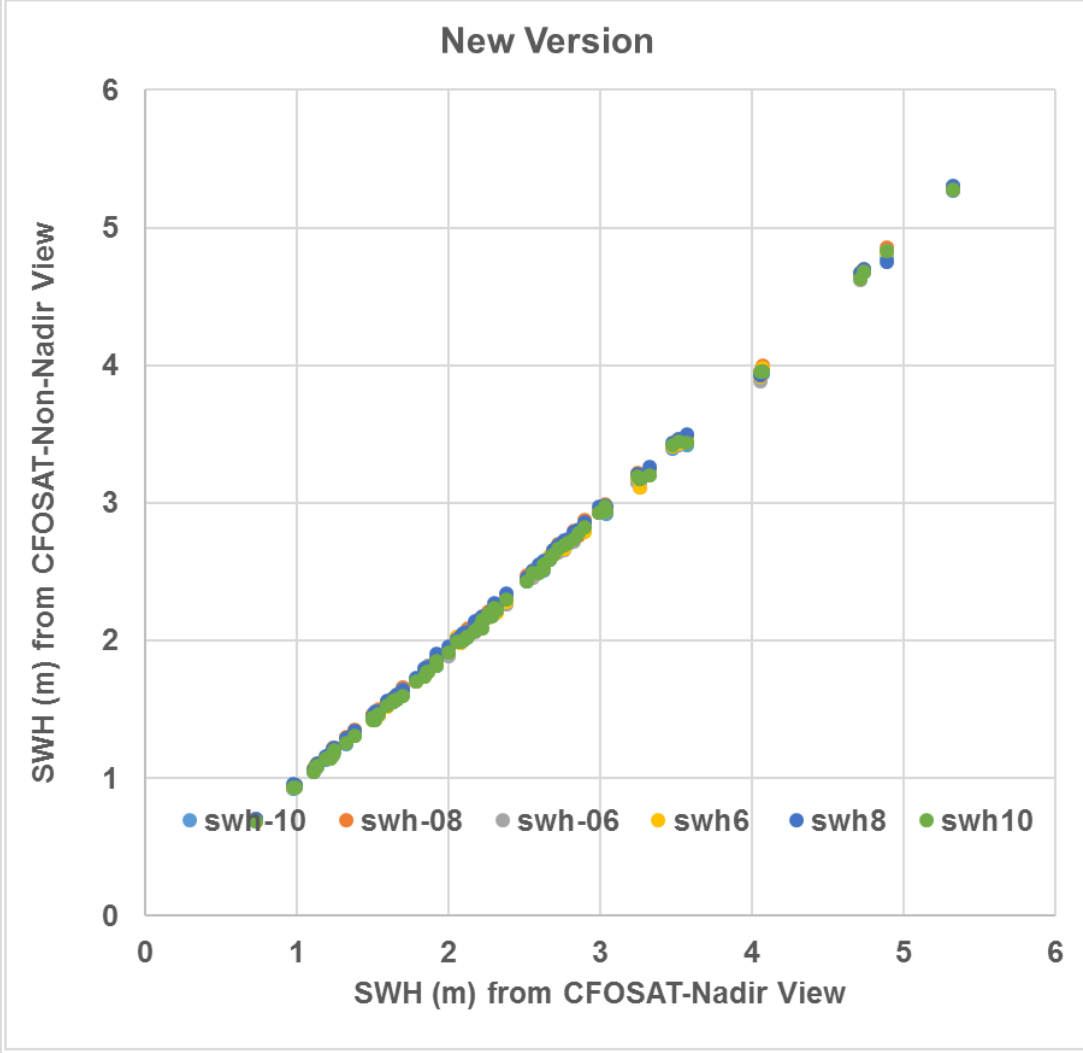


RMSE of various SWH observations with respect to Buoy for March 2020

Improvement of SWH quality from the Previous version

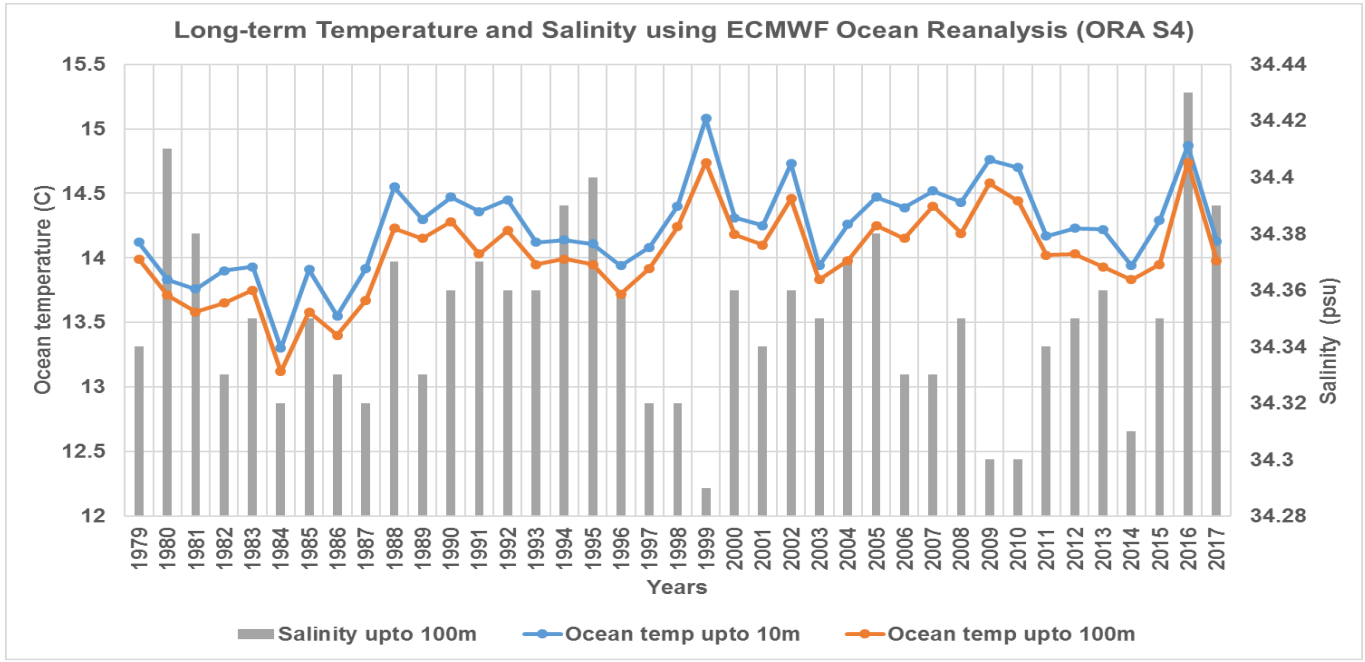
Improvement between two data version

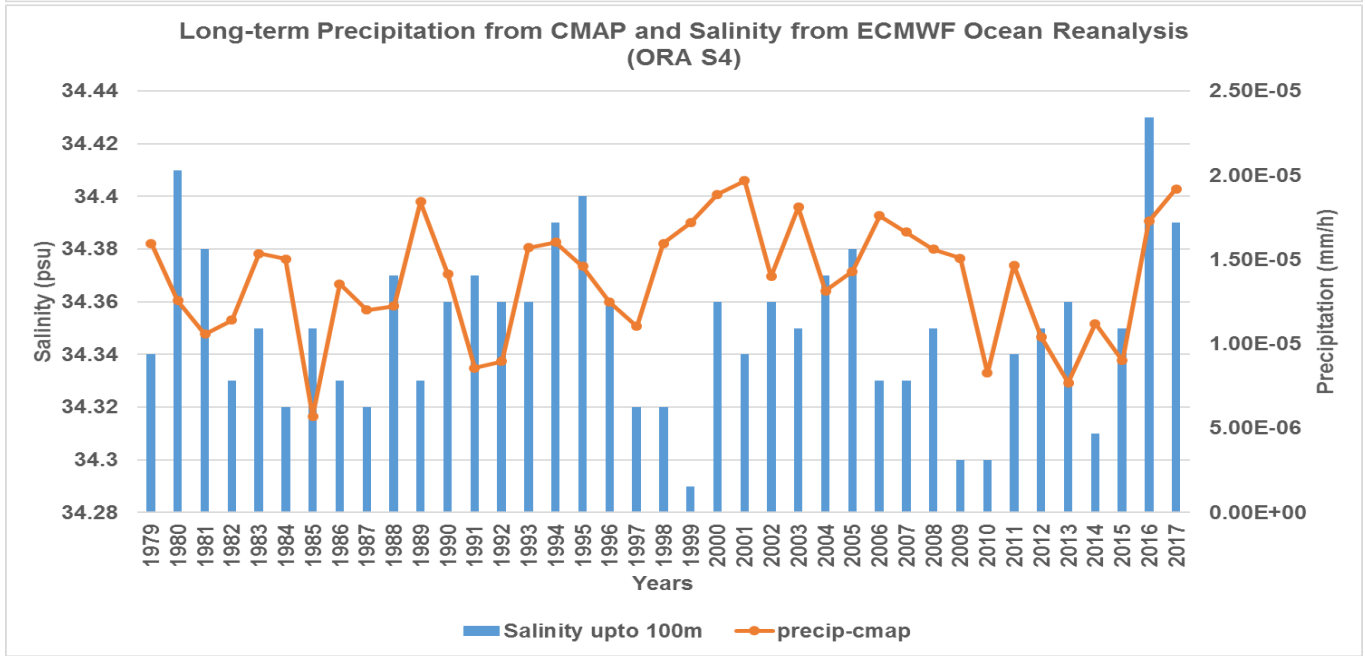




Impact of the CFOSAT geometry on wave variability studies

Area: North West Pacific ocean in Japan Sea

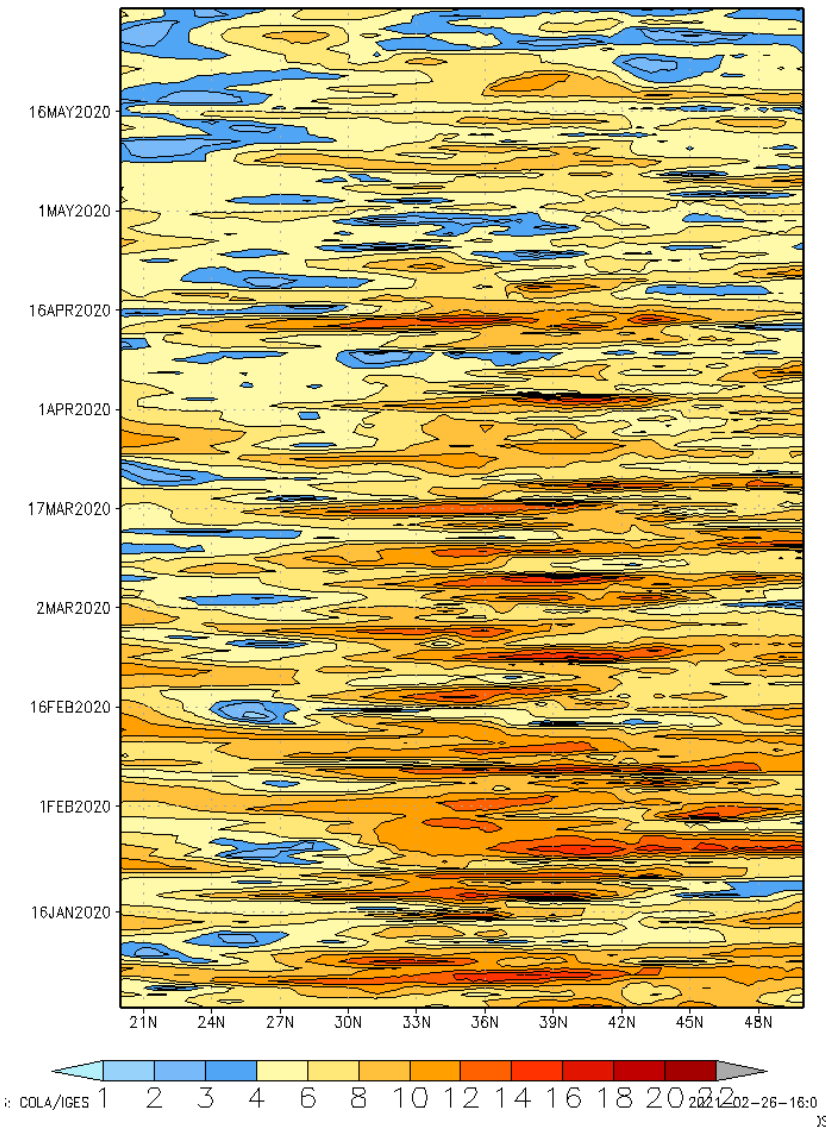




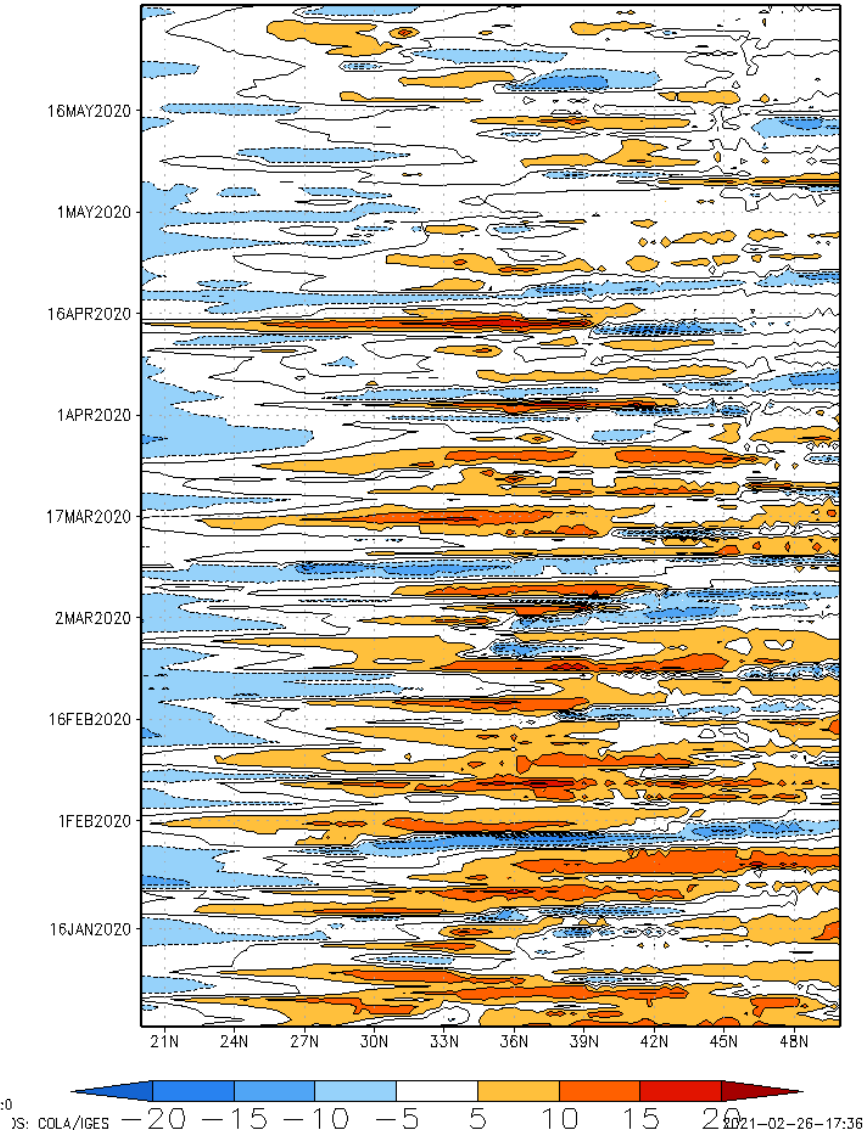
Salient Feature of the Area:

1. The Ocean temperature averaged over 10m depth and 100m depth varies trivially, indicating a thoroughly mixed ocean in presence of **high winds**.
2. Unlike BoB, Freshening under action of precipitation also does not create any stratification.
3. Synoptically the area around 30 deg is junction of Hadley and Ferrel cell and is highly influenced by the variability of ITCZ.
4. On a daily scale SCATSAT indicates persistently high surface wind between Jan-Apr.
5. At surface level stable westerly is observed between Jan –April as we have equinox in March
6. The region is part of Subtropical high pressure belt with strong subsidence from upper level and strong wind velocity shear at surface level.

March-2020



surface wind



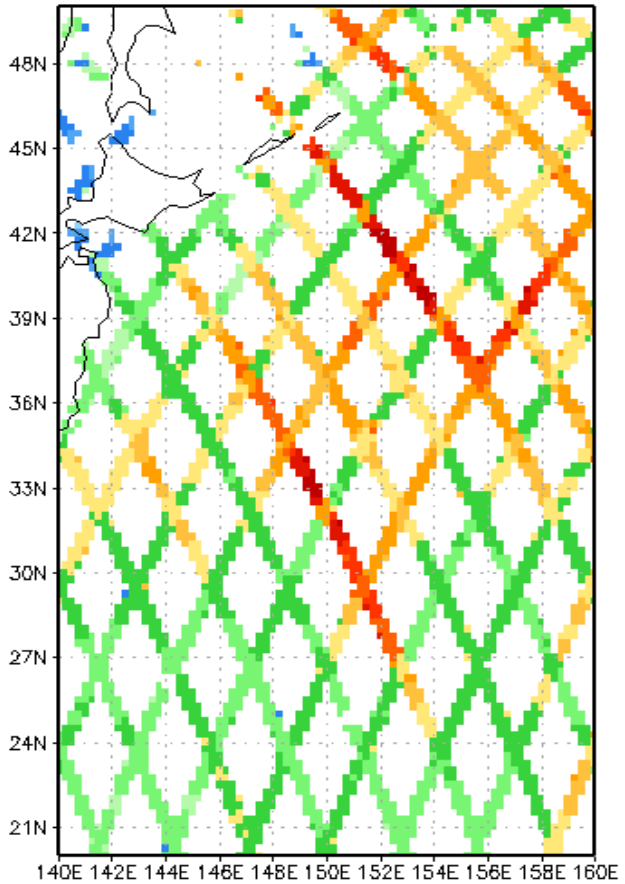
Zonal Wind

Analyzed SCATSAT Winds for Jan-June 2020 over the area

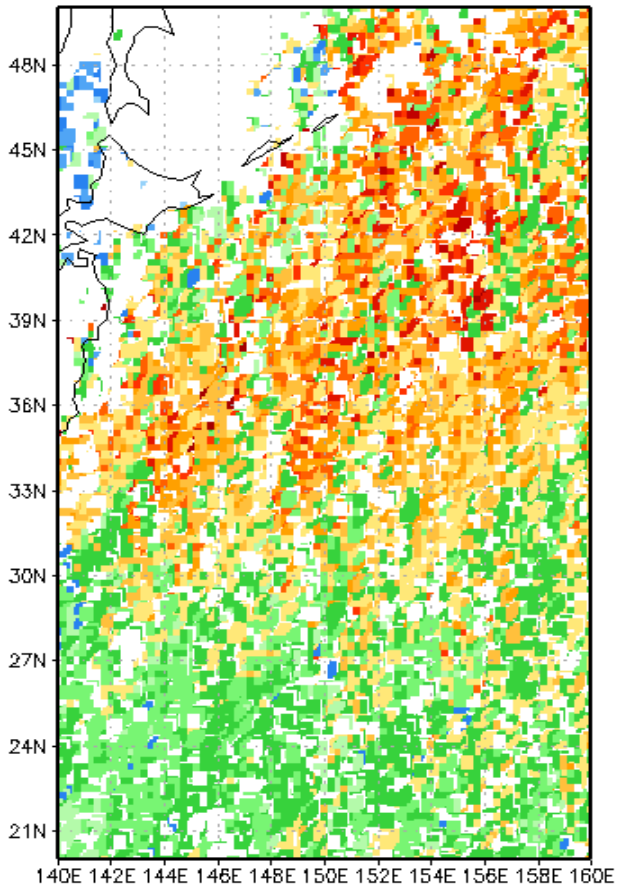
Study Objective: What kind of wind wave diurnal variability happens over here?

Observation Requirement for variability study at a diurnal scale:

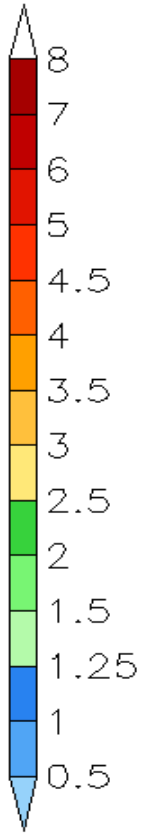
1. **Observations at various synoptic hours like 00, 06 12 and 18**
2. **More Cross over points where we have collocated observations at a temporal difference**

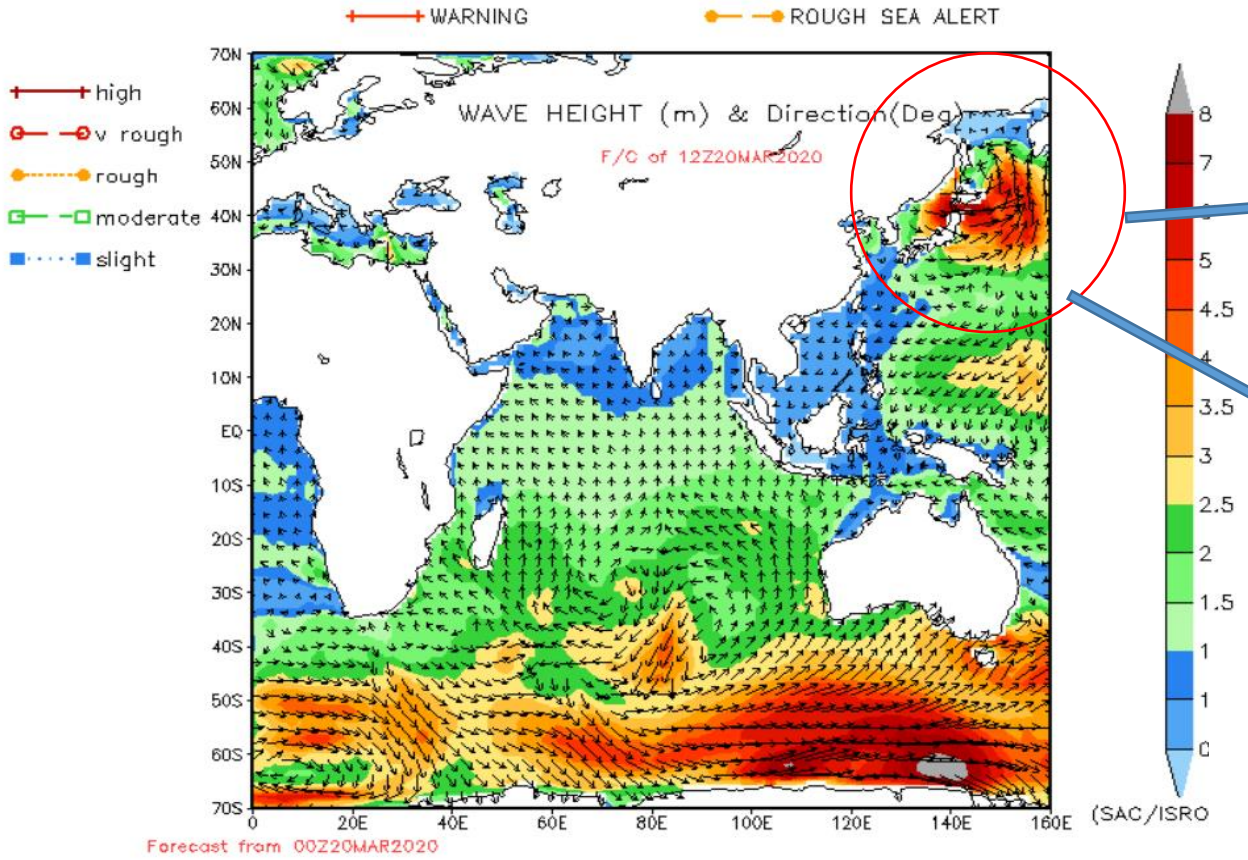


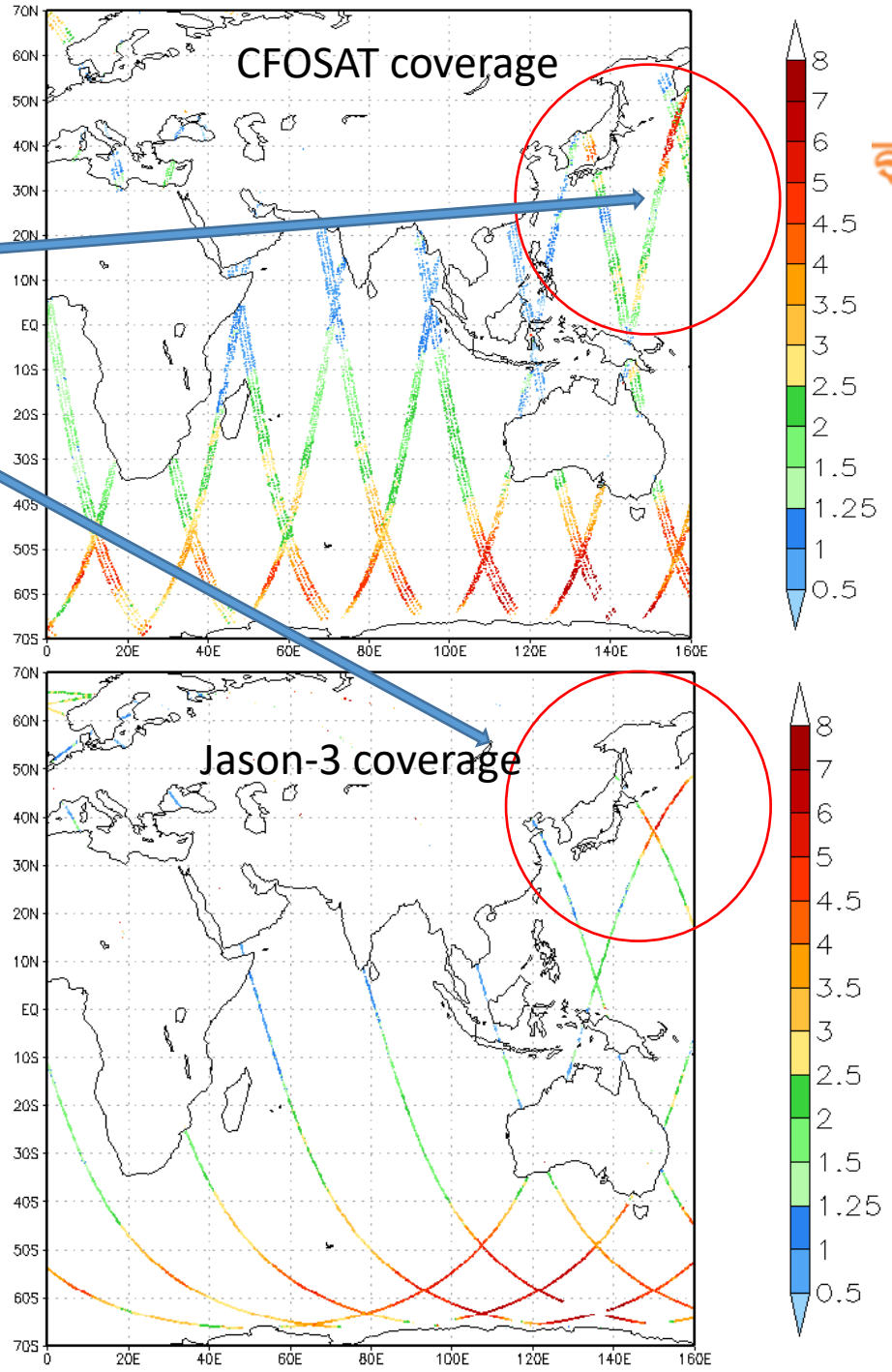
Jason-3 coverage



CFOSAT coverage



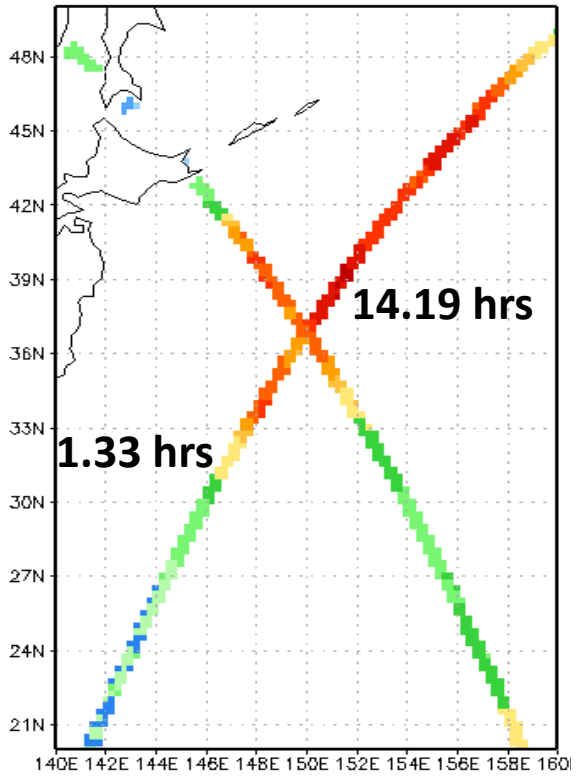


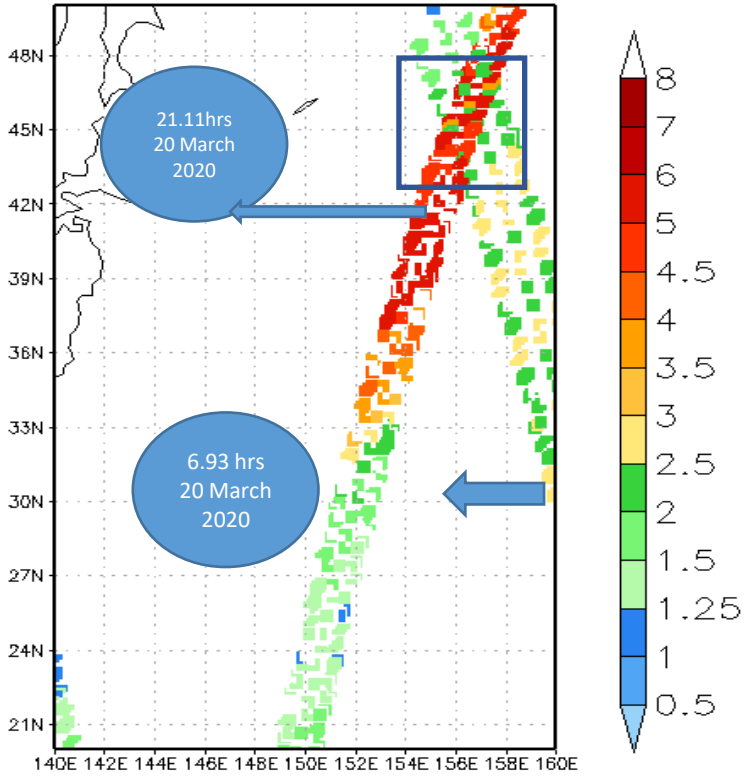


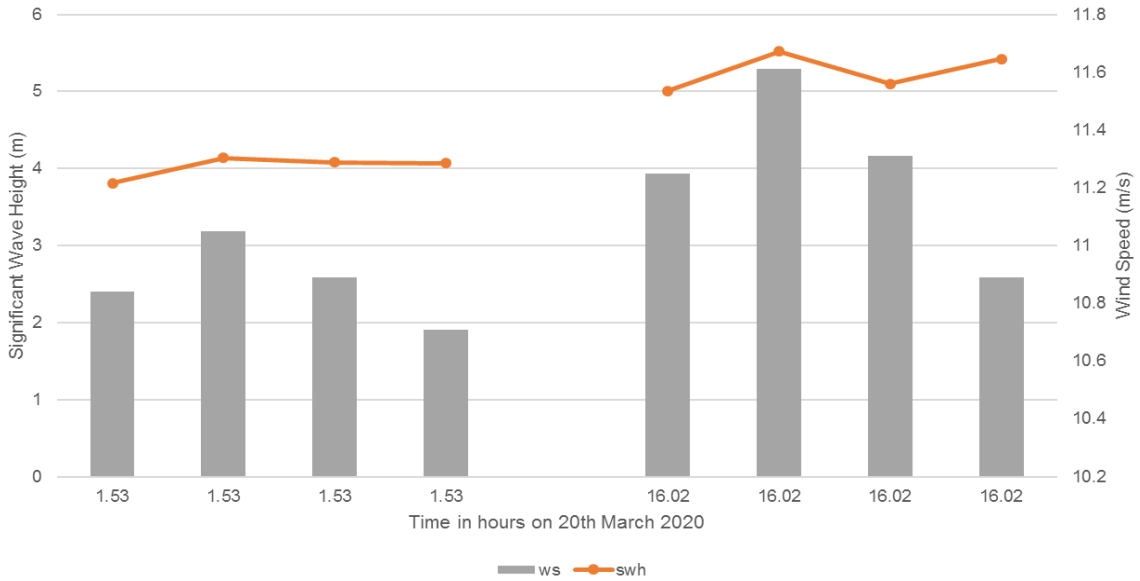
On 20 March-2020

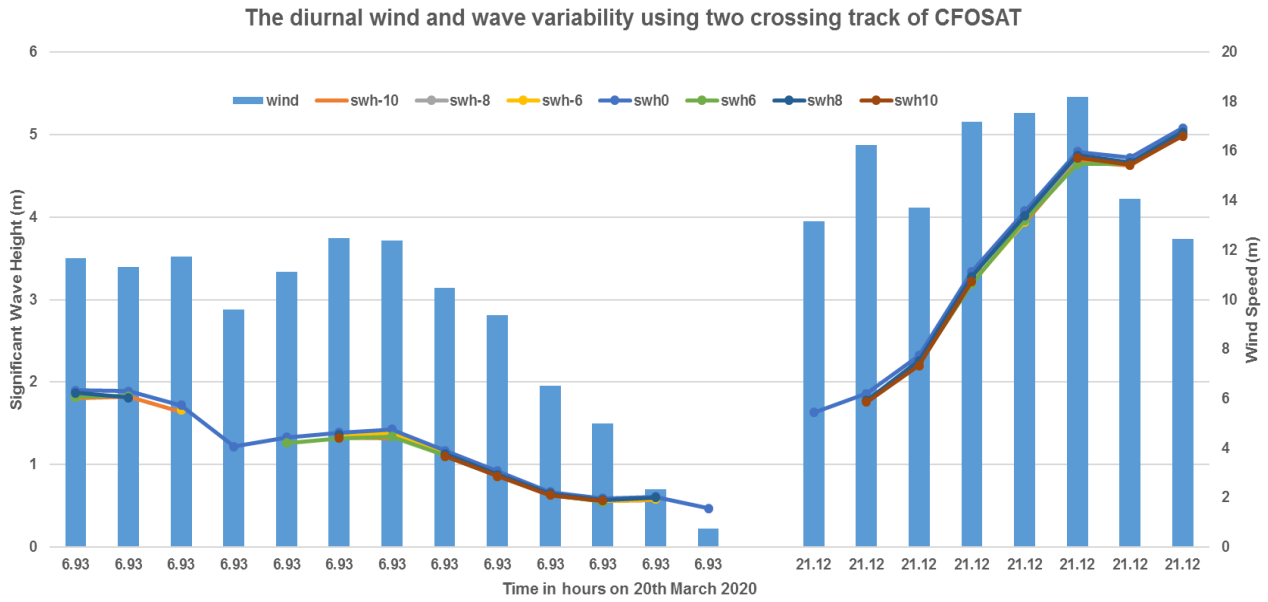
Both model and observations (CFOSAT and Jason3 shows existing high waves in the study area

- Both Jason-3 and CFOSAT had pass crossovers at indicated time.
- The crossover of CFOSAT is much wide which had large number of purely observed wind and wave information at a temporal difference of several hours unlike the precise crossover of Jason-3

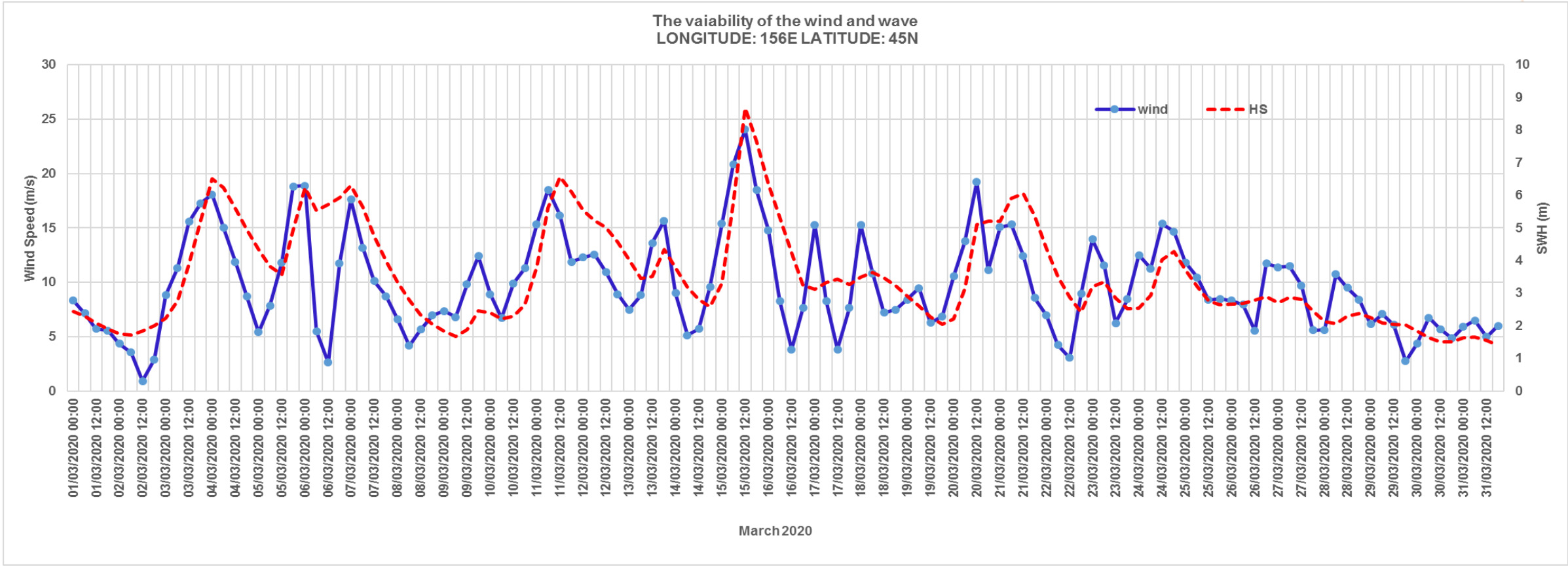








Numerical models also captures the diurnal variability over this region.



Wave Watch -3 SWH and Wind over the area capturing the diurnal variability (assimilates Sentinel, SARAL and Jason-3)

An attempt to assimilate the SWH of CFOSAT in wave model

Method

- SWIM SWH assimilated into the Wavewatch-III model. SWH measurements from nadir (1Hz data) and off-nadir (based on whole combined spectrum) beams are used for assimilation
- Optimal Interpolation technique is used for assimilation
- WWIII model is operational at ISRO ingests Jason-3 SWH
- Forcing winds are obtained from National Centre for Medium Range Weather forecasting (NCMRWF), India
- Model is spun-up for 15 days starting from 15th October - 01st November 2020 without assimilation
- Three sets of model simulations are performed from 01-30th November, 2020

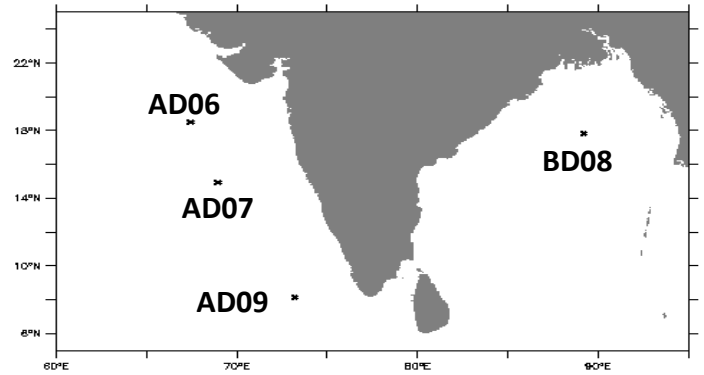
1. Analysis run without any assimilation, called the control run
2. Assimilation of only Jason3 SWH
3. Both Jason3 and CFOSAT SWH are assimilated

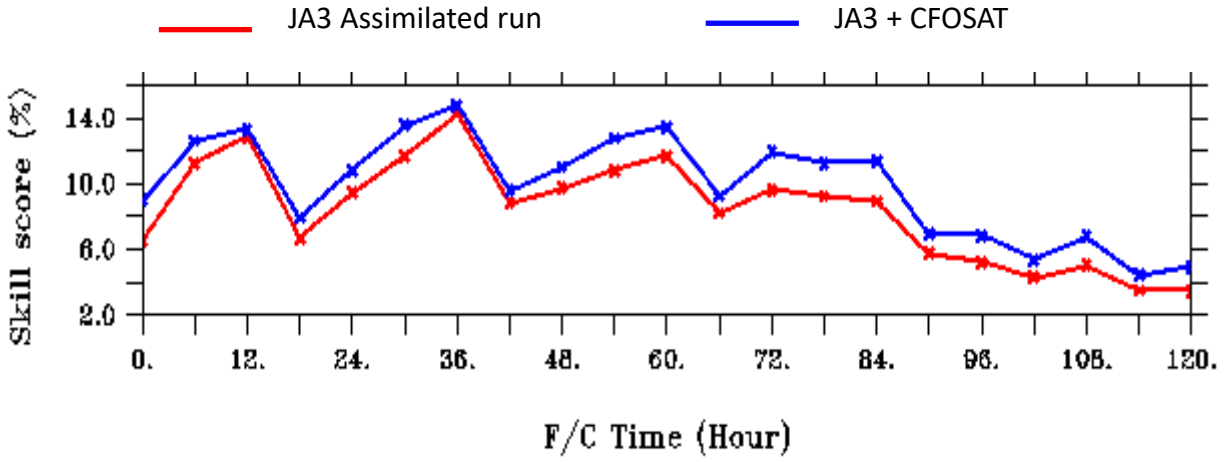
- Validation of model forecasted SWH with available in-situ buoy observations (AD06, AD07, AD09 and BD08) during November 2020

Major Takeaways

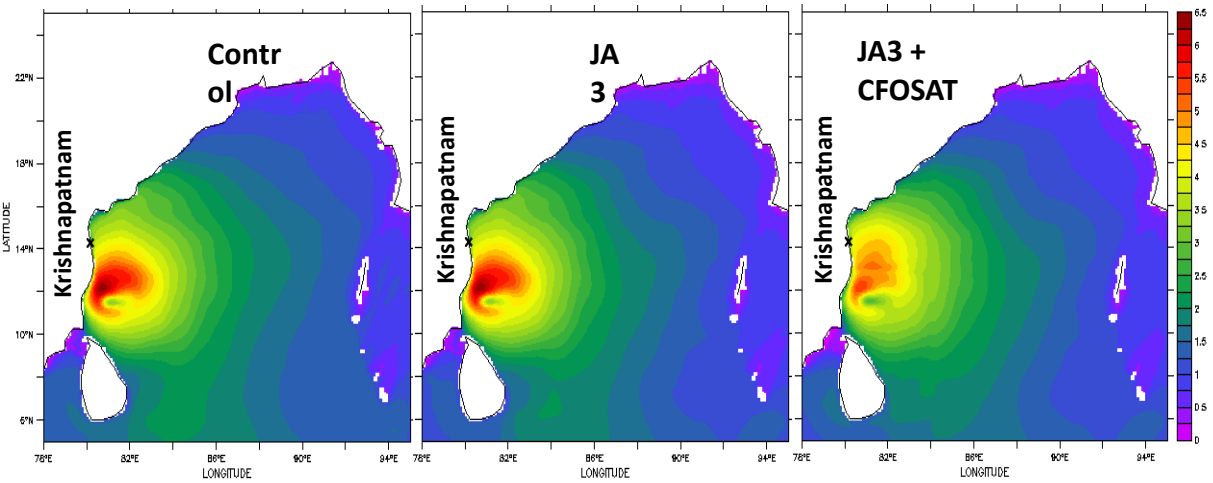
- Impact of assimilating Jason3 and CFOSAT SWH persists throughout the whole forecast period
- Assimilation of Jason3 SWH alone improved the wave forecast by ~ 4-14 % with respect to the non assimilated run
- Assimilation of CFOSAT SWH along with Jason3 SWH further improved the wave forecast (~6-15%)

Location of in-situ buoys

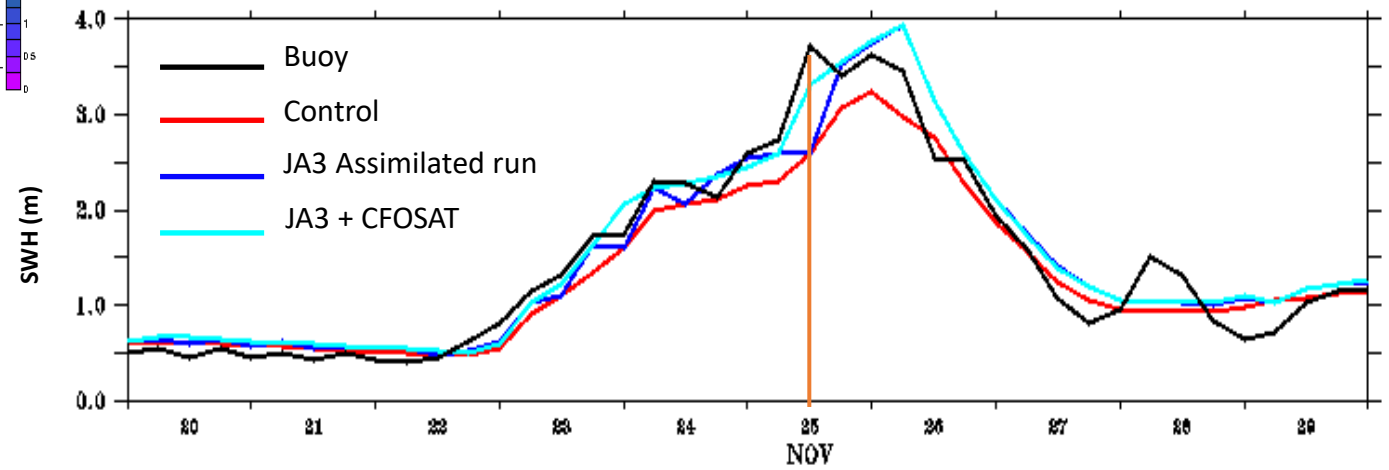




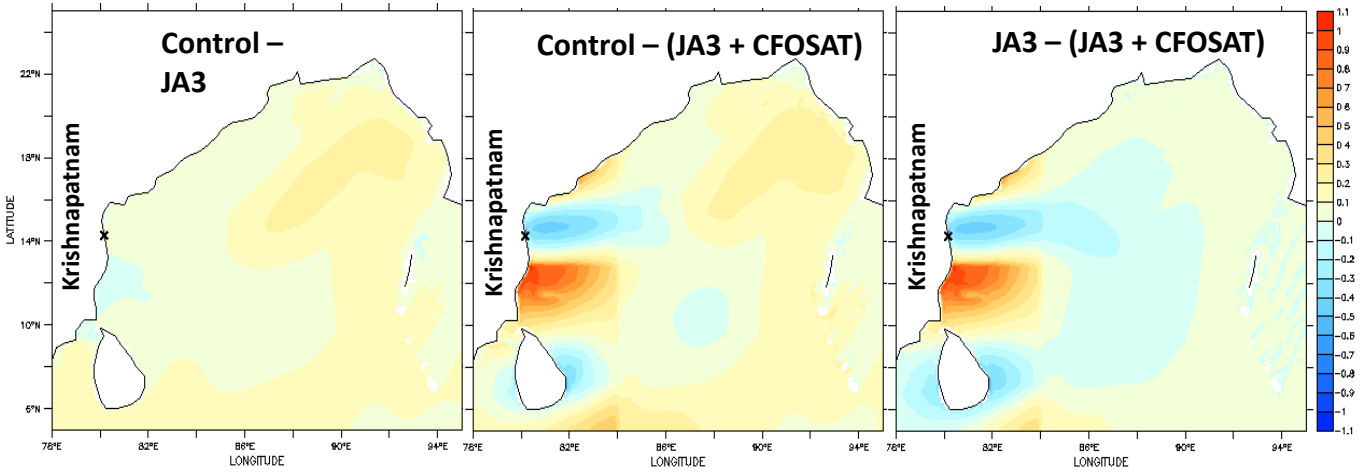
Cyclone Nivar a Case Study



Model simulated analysis field of SWH (m) valid for 25th November 2020 12 UTC



Time-series of model simulated analysis field of SWH (m) with respect to buoy observation (at Krishnapatnam) during cyclone 'Nivar'



Difference in SWH (m) field valid for 25th November 2020 12 UTC

% Error wrt to buoy observations

Cnrtl: 30%

J3 Assim: 30%

J3+CFOSAT:11%

CFOSAT contributes around 19% improvement in high cyclonic wave prediction in this particular case due to availability of more data points

THANKS